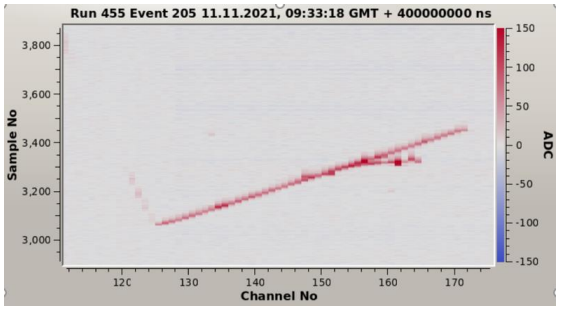
TDE Meeting 21/3/2023
Preparation for FDR

D. Autiero (IP2I), T. Hasegawa (KEK)



TDE FDR:

Originally foreseen date end of March moved to May 15th (one day) + QA on May 17th (final dates communicated by Review Office this morning)

Review page:
https://indico.fnal.gov/event/58976/ (not yet updated for the dates/charge etc..)

FDR Content:

- TDE design. For the electronics components already mature at the time of PDR (https://indico.fnal.gov/event/53543/) and implemented in the tests of the two final top-drift CRPs)
- Successful completion of TDE tests with two top-drift CRPs (CRP2-CRP3) in 2022
- Chimneys prototyping and design (prototyping and testing follows a parallel path to Module-0)
- Various engineering documents proper of the FDR level
- Response to PDR recommendations

FDR is a 90% design completion review, for missing or in progress items it should be indicated at the review a clear path for completion

From Steve's presentation at the VD information meeting on December 8th about FDRs

https://indico.fnal.gov/event/57368/contributions/256005/attachments/162237/214388/VerticalDrift_meeting_221208_TB_v3.pptx

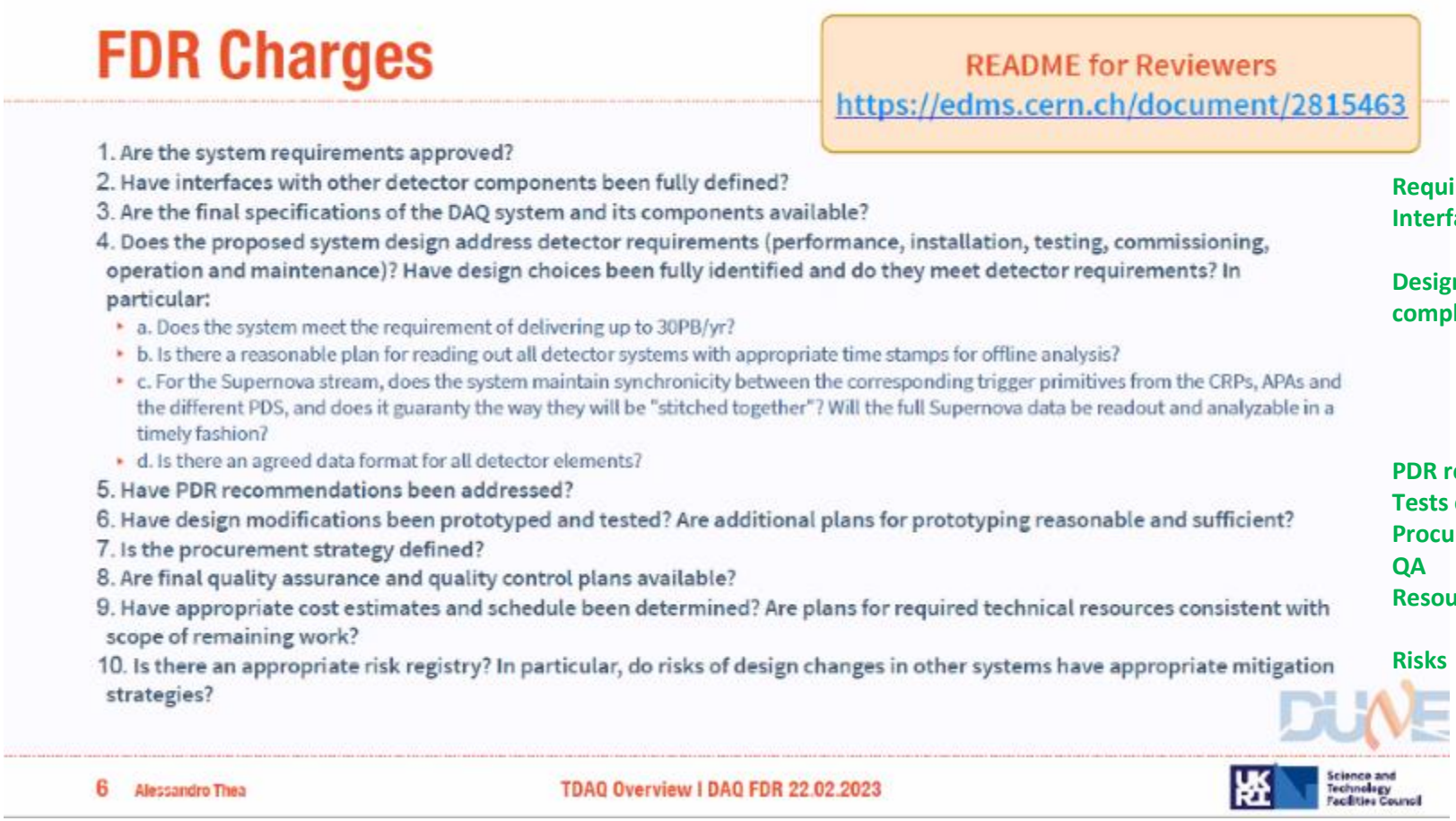
FD2 Final Design Reviews

- Need to complete Final Design Reviews in early 2023.
  - Review Office: edms-CERN-0000204073, fermipoint, Indico
- Build on PDRs from 2022.
- Significant documentation to be completed (edms-2413117)
- Some design decisions need to be resolved
  - Finish designs
  - Finish engineering analyses (mechanical and electrical)
- Finalize models and drawings
- Update interface documents/drawings (edms-CERN-0000224744)
  - Meetings ongoing
- Update requirements (edms-CERN-0000214368)
  - Meetings to come
- Update consortium testing/QC plans (edms-CERN-0000236208)
  - Meetings to come

5 2022.12.08 Vertical Drift General Meeting

Only FDR (concerning FD2) held so far is DAQ on 22 Feb
https://indico.fnal.gov/event/57752/

Charge letter (we do not have yet a Charge letter for TDE, some specifities in FDR, but we can look in the DAQ Charge for a generic structure in common to all FDR)



Requirements/specs
Interfaces

Design choices completed

PDR recommendations
Tests completion
Procurement
QA
Resources

Risks

FD2 Charge Readout Plane System

20–21 April 2023

The committee is requested to review the final design of the DUNE FD2 Charge Readout Plane system (CRP). The review scope includes all mechanical and electrical aspects of the CRP design, including components mounted on the CRPs (excluding BDE modules and patch panels) and the CRPs themselves, but not the support structures that will be reviewed in the installation FDR. A summary of the documents released for this review can be found in edms-2826012. For reference, the report from the CRP Preliminary Design Review can be accessed at edms-2681921.

The committee should assess whether the design is expected to meet the technical specifications, and whether the design maturity and documentation, including production planning, are appropriately advanced for this stage of the project (90% complete). For reference, the LBNF/DUNE Review Plan (edms-2173197) and DUNE Far Detector FDR deliverables (edms-2413117) are available in edms.

The committee should consider:

1. How design choices satisfy the requirements:
    - Have the top and bottom prototypes demonstrated adequate performance?
    - Have the technical risks been identified with appropriate mitigation in place.
2. The completeness of the documentation of mechanical specifications, including 3D model and the 2D drawings for standard and custom components as well as the Compliance Office evaluation focusing on both safety and the proper application of design codes and standards.
3. The completeness of the documentation of electrical specifications, including system schematics, drawings, connections, and grounding details.
4. Whether installation plans are mature enough to provide assurance that the CRP components, as currently designed, can be safely transported and installed within the detector.
5. Plans for the further testing of CRP components in test stands and ProtoDUNE-VD and whether lessons learned from previous prototypes have been effectively incorporated into the current design.
6. If draft documentation detailing plans for procurement, manufacturing, quality control, and part identifiers exists at a sufficient level of maturity for this stage of the design.
7. If project planning materials including interface documents, risk assessment and schedules exist at a sufficient level of development for this stage of the design.
8. Whether recommendations from previous reviews have been appropriately addressed.
9. Is the present level of effort appropriate for reaching the PRR and are plans in place to fully staff for production? Based on the MoU Annex and Interface Documents, is the scope of the subsystem complete and the contribution from each funding agency sufficiently well defined?

Another example:

CRP FDR Charge Letter

DUNE Final Design Review Charge

FD2 High-Voltage System

6–7 April 2023

The committee is requested to review the final design of the DUNE FD2 High-Voltage System (HVS). The review scope includes all mechanical and electrical aspects of the HVS design, including the field cage and its support, the cathode and its support, delivery of cathode HV and CRP bias voltage. A summary of the documents released for this review can be found in edms-2825811. For reference, the report from the HVS Preliminary Design Review for FD2 can be accessed at edms-2681918 and the report for the FD1 Final Design Review can be found at edms-2812875 (FD1 PDR reports are available at edms-2401088 and edms-2390591).

The committee should assess whether the design is expected to meet the technical specifications, and whether the design maturity and documentation, including production planning, are appropriately advanced for this stage of the project (90% complete). For reference, the LBNF/DUNE Review Plan (edms-2173197) and DUNE Far Detector FDR deliverables (edms-2413117) are available in edms.

The committee should consider:

1. How design choices satisfy the requirements and whether the design choices are reasonable:
    - Is the HV-extender, coupler, feedthrough design sufficiently robust?
    - Is the design for thick and thin field cage profiles appropriate? Are plans for insulators in the area of the extender and FC corners appropriate?
    - Is the cathode design, and associated resistive mesh appropriate?
    - Are the interfaces with the PDS at the cathode and the membrane sufficiently well understood?
    - Is the approach to the field cage profile coating reasonable?
    - Have the technical risks been identified with appropriate mitigation in place?
2. The completeness of the documentation of mechanical specifications, including 3D model and the 2D drawings for standard and custom components as well as the Compliance Office evaluation focusing on both safety and the proper application of design codes and standards.
3. The completeness of the documentation of electrical specifications, including system schematics, drawings, connections, and grounding details.
4. Whether installation plans are mature enough to provide assurance that the HVS components, as currently designed, can be safely transported and installed within the detector.
5. Plans for the further testing of HVS components in test stands and ProtoDUNE-VD and whether lessons learned from previous test stand, NP02 and other prototypes have been effectively incorporated into the current design.
6. If draft documentation detailing plans for procurement, manufacturing, quality control, and part identifiers exists at a sufficient level of maturity for this stage of the design.
7. If project planning materials including interface documents, risk assessments and schedules exist at a sufficient level of development for this stage of the design.
8. Whether recommendations from previous reviews have been appropriately addressed.
9. Is the present level of effort appropriate for reaching the PRR and are plans in place to fully staff for production? Based on the MoU Annex and Interface Documents, is the scope of the subsystem complete and the contribution from each funding agency sufficiently well defined?

Another example:

HVS FDR Charge Letter

DEEP UNDERGROUND NEUTRINO EXPERIMENT

DUNE Final Design Review Charge

FD2 Photon Detection System

18-19 April 2023

The committee is requested to review the final design of the DUNE FD2 Photon Detection System (PDS). The review scope includes all mechanical and electrical aspects of the PDS design, including the membrane and cathode systems. A summary of the documents released for this review can be found in edms-2824342. For reference, the final committee report from the PDS Preliminary Design Review can be accessed at edms-2681915.

The committee should assess whether the design is expected to meet the technical specifications, and whether the design maturity and documentation, including production planning, are appropriately advanced for this stage of the project (90% complete). For reference, the LBNF/DUNE Review Plan (edms-2173197) and DUNE Far Detector FDR deliverables (edms-2413117) are available in edms.

The committee should consider:

1. How design choices satisfy the requirements:
    - Have the chosen design elements been sufficiently well tested including in LAr at cathode HV? Including power over fiber, signal over fiber, DC-DC converters, …
    - Have the components in the cold been sufficiently well validated for 30-year lifetime or if not completely, is there a path to validate?
    - Have the technical risks been identified with appropriate mitigation in place?
2. Whether lessons learned from cold box tests, ProtoDUNE-SP and other prototypes have been appropriately incorporated in the current design and if the design has been validated through the integration, testing, and installation in the cold box and ProtoDUNE-VD.
3. The completeness of the documentation of mechanical specifications, including 3D model and the 2D drawings for standard and custom components as well as the Compliance Office safety evaluation.
4. The completeness of the documentation of electrical specifications, including system schematics, drawings, connections, safety analysis and grounding details.
5. Whether transportation and installation plans are mature enough to provide assurance that the PDS components, as currently designed, can be safely transported and installed within the detector.
6. If draft documentation detailing plans for procurement, manufacturing, quality control and part identifiers exists at a sufficient level of maturity for this stage of the design.
7. If project planning materials including interface documents, risk assessment and schedules exist at a sufficient level of development for this stage of the design.
8. Whether recommendations from previous reviews have been appropriately addressed.
9. Is the present level of effort appropriate for reaching the PRR and are plans in place to fully staff for production? Based on the MoU Annex and Interface Documents, is the scope of the subsystem complete and the contribution from each funding agency sufficiently well defined?

Another example:

PDS FDR Charge Letter

DAQ FDR included a README document (appreciated by the Review) which was answering to the Charge questions and pointing to the related documents

README FOR REVIEWERS

This short document for the reviewers of the DUNE FD DAQ FDR is meant as a helping tool to navigate through the documentation and address the review charge questions.

The main document provided to the reviewers is the DAQ design document (https://edms.cern.ch/document/2812882/1), which starts with the recap of requirements, specifications and external interfaces, details the design and prototype implementation of all the DAQ sub-systems, and finally provides information on the development model, QA and QC, and the project organization.

Are the system requirements approved?

System requirements are stable since the conceptual design phase. They are included in both TDRs for FD1-HD and FD2-VD. They were listed also in the document provided to the reviewers for convenience, in section 2.1, but the document will have to be updated to contain the finally approved EDMS URLs.

Have interfaces with other detector components been fully defined?

The interfaces with the other detector components and consortia are defined and documented in the appropriate interface documents. The sign-off procedure is still ongoing for some of them, but content is final.

FD1-HD TPC/FD2-VD BDE and JT DAQ Consortia Interface Document.
URL: https://edms.cern.ch/document/2088713/8

FD2-VD DAQ and TDE Consortia Interface Document.
URL: https://edms.cern.ch/document/2618999/2

PDS and JT DAQ Consortia Interface Documents.
URL: https://edms.cern.ch/document/2088726/5

JT COMP and JT DAQ Consortium Interface Document.
URL: https://edms.cern.ch/document/2145151/5

JT DAQ Installation Interface.
URL: https://edms.cern.ch/document/2145183/4

Are the final specifications of the DAQ system and its components available?

The final specifications are documented in the DAQ design document: the general system specifications are in chapter 2, while the detailed subsystem specifications are in chapter 4.

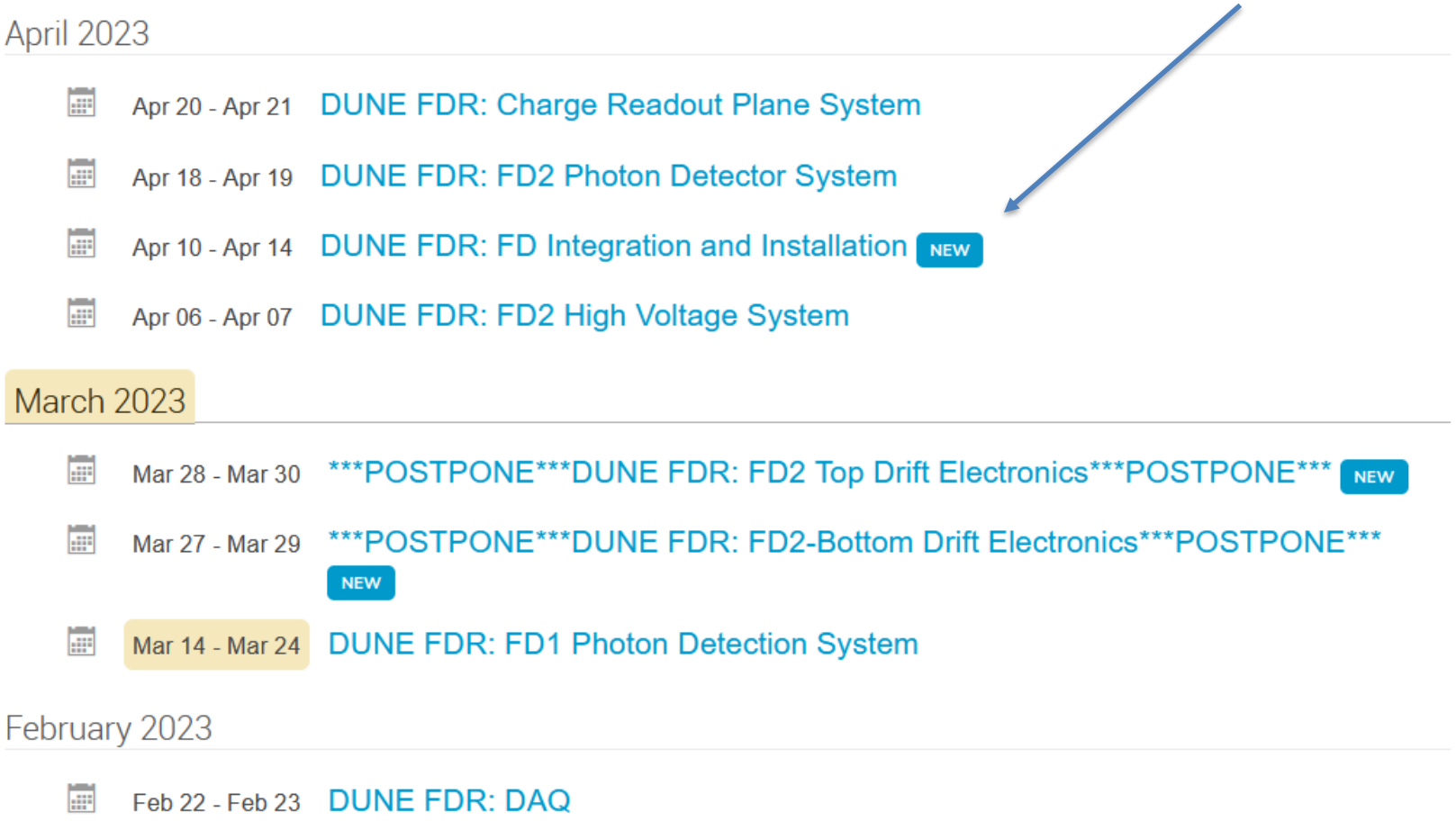
Does the proposed system design address detector requirements (performance, installation, testing, commissioning, operation and maintenance)? Have design choices been fully identified and do they meet detector requirements?

We believe that the proposed system design addresses the detector requirements. Prototype implementations are available for each of the critical components in the DAQ and have shown to satisfy the specifications. More details on how the system is designed and which validation tests were carried out can be found in the design document (chapter 4). Also, the present implementation of the DAQ design is regularly used for reading out DUNE detector components at CERN.

Does the system meet the requirement of delivering up to 30PB/yr?

What foreseen so far for FDRs
https://indico.fnal.gov/category/586/

https://indico.fnal.gov/event/59023/
10/4 Final Design Review of the DUNE FD Integration and Installation: **FD1-HD Installation, FD2-VD Installation, FDC Integration and Installation Infrastructure**
(Charge not yet available)



Documents:

- TDR Chapter
- Document with design updates to TDR (if any)
- Requirements/specs (recently updated)
- Response to PDR recommendations

- Interface documents and drawings (see dedicated slide)
- Risks (recently updated)

- Mechanical drawings (chimneys, see dedicated slide)

- Electrical schematics and board layouts + BOMs (provided for electronics for PDR → complement with the missing ones of the cold/warm flanges)

- Grounding and Shielding plan (TDE grounding and shielding was reviewed with Terry and Linda on Feb 1st) suggested modifications to scheme for better clarity (improved drawing in progress)

- Electrical Safety (https://edms.cern.ch/document/2801355/1) with Electrical Cabling and Wiring (LV distribution system ampacity, fuses) → reviewed with Terry and Linda on January 27th, document in FNAL format under work by Konstantin. → OK for FDR, Terry and Linda require the final document for PRR)

- QA/QC plan (provided in February, reviewed by DUNE QA Team, see slide)

- Prototyping document for electronics (describing tests in 2022)
- Prototyping document for chimenys (development plan in 2023/4)

- Production and planning document (update)
- Installation document (update)
- General improved editing of past documents provided for PDR

Interfaces:

FD2-VD Consortia-Consortia Interface Document Matrix						
	FD2-PDS	FD2-TDE	FD2-BDE	FD2-HVS	FD2-DAQ	FD2-CALCI
FD2-CRP	2619004	2618998	2618995	2619003	No interface	No interface
FD2-PDS		No interface	2618994	2619007	2088726	No interface
FD2-TDE			No interface	No interface	2618999	No interface
FD2-BDE				2726647	2088713	No interface
FD2-HVS					No interface	No interface
FD2-DAQ						No interface

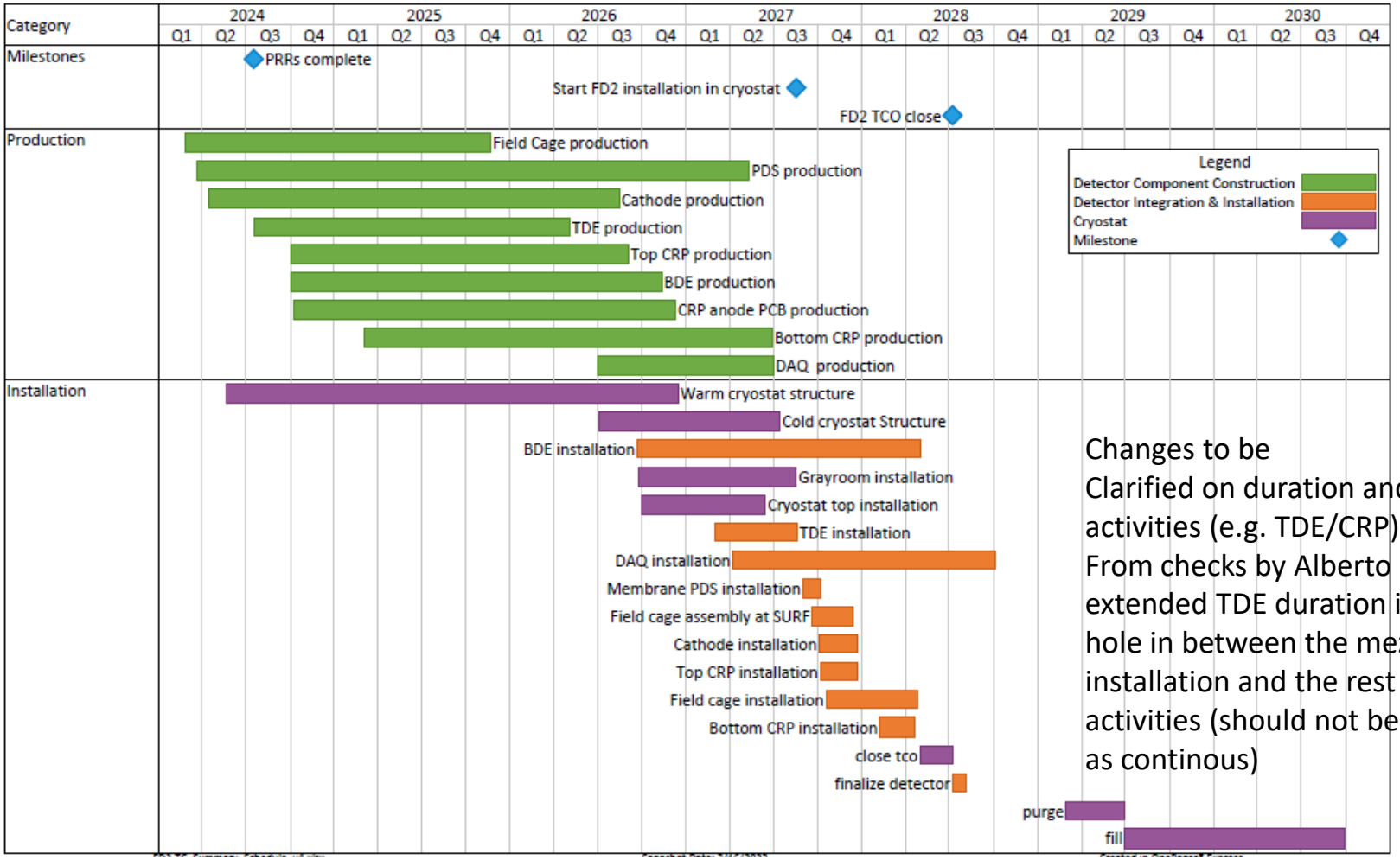
Interface Document	EDMS link
ICD - FDC - DUNE FD1/HD and FD2/VD Consortia	2459132
JT DAQ Installation Interface	2145183
ICD FD2 VD Consortia TDE	2648556
ICD FD2 VD Consortia BDE	2736688
ICD FD2 VD Consortia CRP	2648559
ICD FD2 VD Consortia PD	2648555
ICD FD VD Consortia HV	2648558

- TDE has interfaces with:

DAQ, CRP and ICD

- **DAQ interface has been already finalized (due to DAQ FDR already passed and DAQ-TDE interface aspects reviewed in that occasion)**
- CRP interface will be frozen for CRP FDR (some interface drawings are in progress)
- Changes for Installation document (?) FDR on April 10, changed introduced for installation last week in TDR for resubmission to LBNC of newer version to be clarified
- A formal signoff process of the interfaces is done for the FDR (we had to do it for the DAQ FDR)

From TDR page 397, new version resubmitted to LBNC on March 16th



Changes to be
Clarified on duration and overlap of activities (e.g. TDE/CRP)
From checks by Alberto on P6 the extended TDE duration is due to a hole in between the mezzanine installation and the rest of activities (should not be intended as continous)

Figure 10.6: Vertical drift production and installation schedule, based on FD2-VD production estimates. Gap between TCO closing and purge/filling results from cooling power needs for FD1 filling. (Data from [55])

QA Plan

draft: https://edms.cern.ch/file/2737076/1/DUNE_FD2_Top_Drift_Electronics_(TDE)_Quality_Control_Plan_10Feb2023_v3a.docx

REVISION HISTORY			
Version	**Description of Change**	**Author(s)**	**Effective Date**
1	Initial Release	Dario Autiero	13May2022
2	Update	*Dario Autiero*	17Jan2023
2	Update	*Dario Autiero, S. Galymov*	10Feb2023

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DRAFT

- QA/QC plan provided in February, reviewed by DUNE QA Team, some minor comments under implementation

https://edms.cern.ch/document/2737076/1

Mechanical drawings (details on what requested at FDRs)

Mechanical CAD Model for Sub-system	xxxxxx	Consortium	Updated CAD model for sub-system released in EDMS. As part of the process for releasing the sub-system model, it will be integrated and checked within global CAD model.	Final CAD model that serves as the basis for all production drawings. Although drawings include additional detail beyond that contained within the model, the drawings themselves should be being generated directly from this released model.
Mechanical Engineering Drawings	xxxxxx	Consortium	Engineering drawings for all sub-system mechanical components. Drawings do not need to be production quaility but should contain all crtical dimensions and tolerances. Drawings should be obtained directly from released sub-system CAD model and be marked "Draft/Not for Production". Drawings should also indicate component fabrication materials and masses consistent with EDMS 2281422. Drawings of any specialized components necessary for transporting or installing detector components should also be provided.	Drawings should be of the quality to send to an outside vendor for production and marked "For Module Zero Production". Drawing details should include materials of construction, component masses, pointers to higher-level drawings, default and critical tolerances, part finishes, cleaning procedures, as well as weld parameters and certifications where applicable. All drawings need to be released and set up within a versioning framework providing proper engineering change notification documentation.
Mechanical Assembly Drawings and Parts Lists	xxxxxx	Consortium	Assembly drawings and parts lists for all sub-system detector components. Drawings do not need to be production quality but should contain the baseline design and section views. Drawings should be marked "Draft/Not for Production", contain assembly masses consistent with EDMS 2281422, and indicate the center-of-gravity of the assembly (CG marker) . Parts lists should contain full specifications for any custon components.	Assembly drawings should be of the quality to send to an outside vendor for production and marked "For Module Zero Production". Drawing details should include references to applicable assembly procedures, bills of materials, list of assembly tools to be procured, CG markers, assembly masses (both wet and dry), indications of the proper orientations for asymmetric parts, and pointers to higher-level drawings. All drawings need to be released and set up within a versioning framework that provides proper engineering change notification documentation.

Chimneys:

(last TDE meeting in January
https://indico.fnal.gov/event/53965/contributions/258501/attachments/163357/216221/232601_DUNE_CM_VD_Chimneys.pdf)

Chimneys prototyping and testing follows a parallel path (standalone) to Module-0:

24 cards prototype + 48 cards prototype (24 cards prototype ordered in 2022, both 24/48 cards prototypes foreseen to be tested at IJCLAB in 2023)

Full test of (one) of the two chimenys at CERN in 2024 including cryogenics and full electronics equipement before PRR (electronics to be shared/moved from Module-0)

- We need to describe in a document and present at the review a clear development scheme for the completion of the validation phase

- Thermal simulations, it would be good to write a summary document about the results. Tests showed that a lot of heat exchange of the ASICs happens via the FEB metallic layers and their connection via the KEL connectors to the cold flange (x2 KEL 8901-068-177L-F per card → 2x68=134 pins of 0.8 mm diameter, about 64mm2 cross section) to the cold-flange (do we take that into account in the simulation ?)

- Possible last design completion changes, we should also document them and the related plans

- Interface to cryostat (directly welded chimneys) → finalize this point

→ Need to have a meeting with Jim and point out the difficult chimeny positions

- Blade changes: discussed at TDE session of January CM (Terry's suggestion) to present at FDR the classical design and mention that there is also an alternative design under test for simplication/value engineering

- Completion of PCB flanges design
- Provide all mechanical drawings

- Installation procedure (is there any drawing update for the cart ? Mechanical safety validation needed by Compliance office ? Rodolphe is writing a note on that) Any needs related to Installation FDR ?

Among PDR recommendations:

- *Undergo a safety review through the DUNE Compliance Office prior to FDR*

→ for electrical safety this is handled, compliance office should concern the chimneys installation (see Rodolphes's note)

- *Finalize the cooling studies of the 24-board chimney version before the FDR. Tests done with chimneys loaded with heating boards are to be done before the FDR while tests with chimneys loaded with front-end boards are to be done before the PRR*

→need to specify a plan (see previous comments)

Discussion